VEGETATION TYPE PREFERENCES OF ATTWATER'S PRAIRIE CHICKEN IN COASTAL PRAIRIE[a]

VIRGINIA F. COGAR, Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station
JOHN D. HORKEL, Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station
NOVA J. SILVY, Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station

Abstract: Between February 1975 and June 1977 a total of 5,302 observations of Attwater's prairie chicken (*Tympanuchus cupido attwateri*) activities was made. These observations included 3,698 sightings at booming grounds and 1,604 other sightings (nests, broods, roost forms and individual birds). These data were analyzed according to vegetation type usage. The birds extensively utilized four of eight major vegetation types plus artificially-maintained areas. Of the major vegetation types, the clumped midgrass received the greatest use (88%). Their preference for a vegetation type was apparently determined by the amount of visual obstruction and height of vegetation. Juxtaposition of utilized vegetation types and soil moisture also influenced chicken use of areas.

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The endangered Attwater's prairie chicken is a subspecies of the prairie chicken (*Tympanuchus cupido*). A habitable range for greater prairie chickens is invariably defined as an extensive grassland area (Robel et al. 1970a). The former range of Attwater's prairie chicken included the coastal tall-grass prairies of southwestern Louisiana and southeastern Texas (Lehmann 1941). Currently, the Attwater's distribution is restricted to the gulf coastal prairies of Texas. The actual area occupied and the total numbers of chickens declined since the early 1900's. The population had decreased to approximately 8,700 birds in 1937 (Lehmann 1941), and to an estimated 2,088 birds in 1976 (Brownlee 1977). Some causes of this decline were habitat loss due to woody plant invasion and conversion of native prairie into agronomic production.

Three areas of Texas continue to maintain populations of Attwater's prairie chicken: Colorado and Austin counties (site of the Attwater Prairie Chicken National Wildlife Refuge); Victoria County; and Aransas, Refugio, and Goliad counties. The latter area has the largest concentration of chickens and includes the Tatton Unit of the Aransas National Wildlife Refuge.

The purpose of this study was to gain a better understanding of the habitat requirements of the Attwater's prairie chicken in an area maintaining a dense population. Therefore, observations from Refugio County were analyzed by association of the birds with various vegetation types.

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STUDY AREA

This study was conducted in Refugio County, 28.8 km northeast of Refugio, Texas. Most of the study area was within the borders of the 6,400-ha Lake Pasture of the River Ranch. The topography of the area was dominated by slightly rolling coastal grasslands. Two small drainages of intermittent flow intersected the area. Elevation of the area varied from about 7.6 m to 15.2 m (U.S. Department of Interior Geological Survey Contour Map, 1965). Through recorded history the pasture has remained in native prairie vegetation and has not been fertilized or recently burned. Moderate, continuous grazing of one animal unit per 6.5 ha was maintained throughout the study.

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For the past century the study area has supported a viable Attwater's prairie chicken population. An estimated 250-300 chickens occupied the pasture during the study. Fifteen and 18 booming grounds were utilized by displaying males during 1976 and 1977, respectively.

METHODS AND MATERIALS

Field work began in February 1975 and continued to June 1977. The study area was divided into 8 major vegetation types on the basis of visually dominant plant species. In addition, artificially-maintained areas were recognized as a distinct type. Visual obstruction and height of the vegetation were determined for all nine areas by establishing 28 permanent 60-m transects, chosen subjectively to obtain representative samples of the study area. Steel posts were permanently set at the end of each transect. Vegetation height, visual obstruction, and visual dominance of species were recorded during spring (February-April), summer (May-July), fall (August-October), and winter (November-January). Obstruction measurements were made with a range pole numbered from bottom to top (Robel et al. 1970b). The pole was placed vertically in the vegetation at 2 m intervals along the length of each transect, yielding 30 obstruction measurements per transect. The lowest decimeter or half-decimeter mark visible on the pole was recorded when viewed from a height of 1 m and at a distance of 4 m. The mean of the visual obstruction measurements, from all transects within a given vegetation type, was used as an obstruction index for that vegetation type. The larger the obstruction index, the greater the obstruction of vision. The tallest vegetation present within 10 cm of the range pole was measured at each placement of the pole to obtain a mean maximum height for each vegetation type.

Random daily visual observations were made in each vegetation type to determine the presence or absence of chickens and their associated activities. Observations were made by driving roads and by randomly walking through the vegetation types. Observations in each vegetation type were in proportion to the type's relative abundance. These observations were categorized by vegetation type, season, and types of sightings. Types of sightings included booming-ground sightings; individual sightings; and locations of nests, broods, and roost forms (sites where droppings accumulated in one place from day or night rest periods).

A vegetation preference index (PI) Robel et al. (1970a), determined by dividing the percentage of bird locations in a specific vegetation type by the percentage of the study area covered by that vegetation type, was used to detect the relative usage of each major vegetation type. A PI greater than 1.0 indicated chicken usage greater than that expected if no preference was exhibited by the birds. A value of 1.0 indicated use of an area in proportion to abundance. A value less than 1.0 reflected avoidance, or at least less usage than would be expected if the birds were using each vegetation type in proportion to abundance.

RESULTS

Vegetation on the Study area

The 8 major vegetation types recognized were: (1) spiny aster (*Aster spinosus*), (2) cordgrass (*Spartina sparttinae*), (3) transition, (4) rattlebush (*Sesbania drummondii*), (5) balsamscale (*Elyonurus tripsacoides*) (6) hardpan, (7) unclumped midgrass, and (8) clumped midgrass (Fig. 1). The percentage of the study area occupied by these types and the visually assessed dominant plant species within each type are presented in Table 1.

The cordgrass type was limited to drainage areas that were usually moist. The rattlebush type bordered ponds and occurred in low areas that often contained standing water. The spiny aster type was associated with low, wet drainage areas. Unlike the rattlebush and cordgrass, this type only accumulated water during periods of abundant rainfall.

The balsamscale vegetation type was associated with sandy loam soil. The soil ranged from well to poorly drained depending on depth of the surface soil. Vegetation of this type was characterized by almost continuous clumps of balsamscale.

The clumped midgrass, unclumped midgrass, and transition vegetation types were associated with the clay soils of the study area. Mounds 0.5-1.5 m apart occurred in the clumped midgrass type. These mounds, 12-30 cm tall and 0.5-1.5 m in diameter, supported the dominant bunch-grass vegetation. Low areas between mounds were usually moist and dominated by forbs. Although having similar species composition (Table 1), the unclumped type lacked the characteristic mounds and clumps of bunch-grasses found in the clumped type. Transition areas were a gradation between the midgrass types and

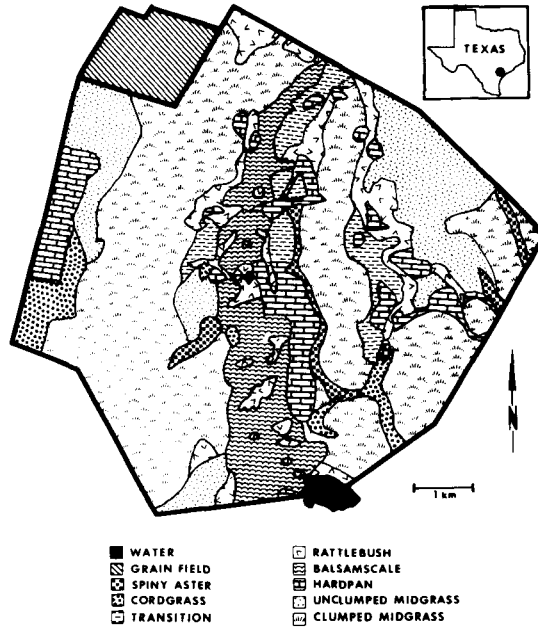

Fig. 1 Cover map depicting the eight major vegetation types of the Lake Pasture, River Ranch, Refugio County, Texas.

Table 1. The visually dominant plants within and the percent composition of the eight major vegetation types of the Lake Pasture, River Ranch, Refugio County, Texas.

Vegetation type	*Percent of study area*	*Visually dominant plants*
Spiny aster	2.5	spiny aster (*Aster spinosus*)[a], baccharis (*Baccharis halimifolia*), sumpweed (*Iva frutescens*), and longtom (*Paspalum lividum*)
Cordgrass	4.3	cordgrass (*Spartina spartinae*) and sumpweed
Transition	5.9	threeawn (*Aristida spp.*) and broomweed (*Xanthocephalum texanum*)
Rattlebush	10.0	rattlebush (*Sesbania drummondii*), broomweed, and sumpweed
Balsamscale	11.0	balsamscale (*Elyonurus tripsacoides*)
Hardpan	11.2	whorled dropseed (*Sporobolus pyramidatus*), Texas willkommia (*Willkommia texana*), shortspike windmillgrass (*Chloris subdolichostachya*), tasajillo (*Opuntia leptocaulis*), Texas prickly pear (*Opuntia lindheimeri*), and Devils pincushion (*Echinocactus texensis*)
Unclumped	18.0	tall dropseed (*Sporobolus asper*), Texas grama (*Bouteloua rigidiseta*), Texas wintergrass (*Stipa leucotrichia*), ruellia (*Ruellia nudiflora*), ragweed (*Ambrosia psilostachya*), broomweed, and sumpweed
Clumped	33.6	tall dropseed, little bluestem (*Schizachyrium scoparium*), sumpweed, broomweed, ragweed, indiangrass (*Sorghastrum nutans*), and big bluestem (*Andropogon gerardii*)

[a]Common and scientific names follow Gould (1975).

the hardpan type and shared plant species common with both. The vegetation on transition sites was shorter and less abundant than in the midgrass types (Table 2).

Table 2. Mean obstruction indices, mean maximum vegetation height (cm), and number of transects established for the nine vegetation types of the Lake Pasture, River Ranch, Refugio Co., Texas, during 1976.

Vegetation type	*Season*	*Number of transects*[a]	*Obstruction index*		*Vegetation Height*	
			X[b]	*S.D.*	X	*S.D.*
Spiny Aster	Spring	2	2.05	1.06	45.4	26.6
	Summer	2	3.06	1.49	41.9	18.0
	Fall	2	4.08	1.45	60.8	18.5
	Winter	2	3.10	1.25	52.1	20.5
	Year	8	3.07	1.96	50.1	22.2
Cordgrass	Spring	1	7.10	1.80	79.7	22.9
	Summer	1	6.22	1.92	80.0	12.2
	Fall	1	7.90	1.61	84.9	24.0
	Winter	1	6.43	1.73	77.8	21.2
	Year	4	6.91	1.87	80.6	20.4
Transition	Spring	4	1.42	0.50	47.2	13.6
	Summer	4	2.00	0.50	49.5	12.5
	Fall	4	3.30	1.46	49.9	14.3
	Winter	4	2.03	0.67	44.3	18.2
	Year	16	2.19	1.11	47.7	14.9
Rattlebush	Spring	3	2.14	0.81	55.7	39.5
	Summer	3	2.51	1.15	51.9	35.2
	Fall	3	5.09	2.23	81.2	34.1
	Winter	3	3.00	1.32	66.5	35.1
	Year	12	3.19	3.09	63.8	37.6
Balsamscale	Spring	2	3.04	1.38	78.9	34.1
	Summer	2	3.27	4.24	61.9	24.5
	Fall	2	4.41	1.19	74.2	23.8
	Winter	2	3.15	1.32	65.3	28.6
	Year	8	3.47	2.44	70.1	28.6
Hardpan	Spring	3	1.17	0.71	24.2	16.1
	Summer	3	1.38	0.64	22.6	12.9
	Fall	3	1.58	0.89	24.8	12.1
	Winter	3	1.34	0.55	23.5	11.8
	Year	12	1.37	0.72	23.8	13.3
Unclumped	Spring	4	2.02	0.57	52.0	13.4
	Summer	4	2.21	0.47	48.8	13.8
	Fall	4	3.84	1.52	53.6	14.7
	Winter	4	2.90	1.23	48.8	20.2
	Year	16	2.74	1.27	50.8	15.8
Clumped	Spring	7	2.22	0.76	49.2	20.8
	Summer	7	2.47	0.77	42.9	14.0
	Fall	7	3.42	0.89	55.5	16.1
	Winter	7	2.65	0.85	50.4	18.2
	Year	28	2.69	0.93	49.5	17.9
Artificial	Spring	2	0.96	0.25	10.1	4.5
	Summer	2	1.45	0.44	29.2	8.8
	Fall	2	1.29	0.35	18.8	7.3
	Winter	2	1.08	0.18	10.8	5.7
	Year	8	1.20	0.36	17.2	10.2

[a]N is 30 (number of observations per transect) times the number of transects.
[b]Large index number implies high obstruction of vision.

The hardpan type occurred on areas of very compact, impermeable soil that had short sparse vegetation.

The clumped midgrass vegetation type occupied the largest portion of the study area and the spiny aster type the least (Table 1). The tallest vegetation type with the greatest obstruction was the cordgrass type, while the artificial type had the least obstruction and shortest vegetation (Table 2). There was a high correlation ($r = 0.84$) between vegetation height and visual obstruction of the vegetation types.

Although not a true vegetation type, artifically-maintained areas such as mowed roadways, oil pipeline rights-of-way, roads, and oil well pads created areas that differed from the other vegetation types. These areas were numerous throughout all vegetation types. Plant species associated with the artificially-maintained areas were similar to those of the adjacent vegetation types.

Trees and shrubs had invaded approximately 3.5 percent of the study area. Hardpan, balsamscale and the midgrass types were the areas most frequently invaded. Except for a single large live oak (*Quercus virginiana*) mott, most of the invasion was by mesquite (*Prosopis glandulosa*) and huisache (*Acacia farnesiana*). Understory vegetation was dominated by species of the original vegetation type.

Although the Lake Pasture contained no cropland, there was a 311-ha field adjacent to the west corner of the Pasture (Fig. 1) where grain sorghum was grown during the study. Other cropland was approximately 12.6 km from the Lake Pasture.

Prairie Chicken Observations

A total of 3,698 booming ground observations (Table 3) was made on 27 sites of naturally occurring hardpan or on artificially-maintained areas adjacent to midgrass vegetation types (Fig. 2). Of these observations, 85 percent were associated with artificially

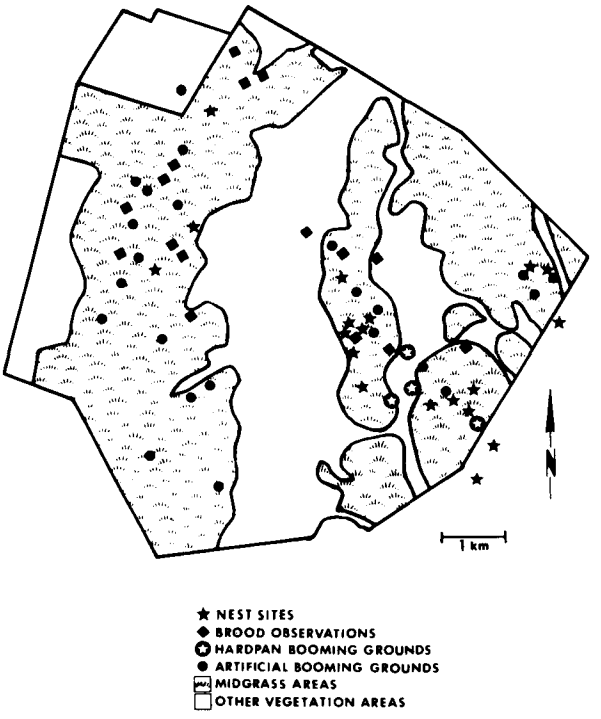

Fig. 2. The location of nest sites, brood observations, and booming grounds showing their association with midgrass areas of the Lake Pasture, River Ranch, Refugio County, Texas.

maintained areas and 15 percent with hardpan vegetation. Hardpan booming grounds were the last to be established and the first to be abandoned. There was a greater use of booming grounds during winter and spring than during summer and fall.

Sixty-eight percent of the 19 Attwater's prairie chicken nests were in the clumped midgrass and 32 percent in the unclumped midgrass (Table 3). Of 16 broods observed,

Table 3. Distribution of 5,302 Attwater's prairie chicken locations by vegetation type and type of activity in the Lake Pasture, River Ranch, Refugio Couny, Texas.

Vegetation type	*Non-booming activities*				*Subtotal non-booming activities*	*Booming activities*	*Total activities*
	Nests	*Broods*	*Forms*	*Individual*			
Spiny aster			1		1		1
Cordgrass			6	9	15		15
Transition		1		27	28		28
Rattlebush							
Balsamscale							
Hardpan				5	5	437	442
Unclumped	6		65	32	103		103
Clumped	13	4	327	137	481		481
Subtotal	19	5	399	210	633	437	1,070
Artificial		11		960	971	3,261	4,232
Total	19	16	399	1,170	1,604	3,698	5,302

69 percent were in artificially-maintained areas, 25 percent in clumped midgrass, and 6 percent in transition areas. All broods less than 5 weeks of age were seen in clumped midgrass. Older broods were observed more often in the artificially-maintained areas associated with clumped midgrass (Fig. 2).

Of 399 roost forms located, 82 percent were in clumped midgrass and 16 percent in unclumped midgrass vegetation types (Table 3). One roost form was found in the spiny aster type and six were located in the cordgrass type.

Eighty-two percent of the 1,170 individual sightings were in artificially-maintained areas, 12 percent in clumped midgrass, 3 percent in unclumped midgrass, 2 percent in transition areas, and less than 1 percent in hardpan areas (Table 3). On several occasions, chickens which flushed from other vegetatioin types were observed to fly into either balsamscale, rattlebush, or spiny aster. However, lack of sightings and failure to find roost forms indicated these three types were seldom used by the birds.

The most obvious season change in vegetation use was the usage of hardpan and artificially-maintained areas for booming grounds during the late winter to late spring period. Other apparent seasonally-associated changes probably were due to inadequate sample size.

Vegetation Preference Indices

Openness of the artificial areas and booming grounds made the birds more visible on these areas. Therefore, these types of observations were excluded when vegetation PIs were calculated. The problem of differential observability in the eight major vegetation types was lessened because roost forms could only be seen when underfoot and birds flushed only when underfoot.

Of the 633 non-booming ground and non-artificial area observations, 76 percent were in clumped midgrass vegetation (Table 3). This was the only vegetation type with a PI indicating positive selection for the entire year, annual PI of 2.3 (Table 4). Unclumped midgrass had the second largest number of observations (16%) and had the second largest annual PI (0.9). The PI for the unclumped midgrass type indicated positive selection only during the summer and winter. The transition type had the third highest annual PI (0.7), but only had positive selection during the summer period (1.3). Hardpan (0.1) and cordgrass (0.6) annual PIs showed negative selection. There was a positive

Table 4. Vegetation type preference indices (percent of bird sightings/percent of study area) by season calculated from 633, non-booming and non-artificial area, Attwater's prairie chicken observations in the Lake Pasture, River Ranch, Refugio County, Texas.

Vegetation type	*Percent of study area*	*Number of sightings*	*Preference index*				*Weighted means*
			Spring	*Summer*	*Fall*	*Winter*	
Spiny aster	2.5	1	0.3	0.0	0.0	0.0	0.1
Cordgrass	4.3	15	2.3	0.0	0.0	0.0	0.6
Transition	5.9	28	0.0	1.3	0.8	0.9	0.7
Rattlebush	10.0		0.0	0.0	0.0	0.0	0.0
Balsamscale	11.0		0.0	0.0	0.0	0.0	0.0
Hardpan	11.2	5	0.2	0.0	0.0	0.0	0.1
Unclumped	18.0	103	0.6	1.6	0.0	1.1	0.9
Clumped	33.6	481	2.3	1.7	2.8	2.2	2.3
Total		633					

selection for the cordgrass areas during the spring (2.3), however, this was based on only one group of males. No use was recorded for the cordgrass throughout the remainder of the study.

DISCUSSION

Observation in the Lake Pasture study area from February 1975 to June 1977 revealed that Attwater's prairie chicken primarily used four (clumped midgrass, unclumped midgrass, transition, and hardpan) of the eight major vegetation types present. However, artificially-maintained areas were used extensively, when adjacent to either the clumped midgrass, unclumped midgrass, or transition vegetation types.

Vegetation on hardpan and artificial areas used for booming was short, and on some of the roads and oil well pads the vegetation was nearly absent. Jones (1963) noted that courtship areas of the greater prairie chicken were of low physiognomy and within easy flight distance of a nesting area. Shorter vegetation on the artificially-maintained areas may have accounted for the greater use of this type for booming. In addition, early fall and spring rains transformed most of the low hardpan areas to small lakes during the beginning and end of the booming season. Undoubtedly this affected the acceptability of this type for booming.

Mown pipeline rights-of-way were readily used as booming sites as long as they were kept mowed, but were abandoned if left unmowed. Mown pipeline rights-of-way were used only when they intersected the midgrass habitat types. Elevated roads and oil well pads constructed within prairie chicken roosting and nesting areas were readily utilized as booming grounds. Areas of low vegetation were used as booming grounds only when they were adjacent to midgrass areas. Only one of several hundred Attwater's prairie chicken booming grounds observed by Lehmann (1941) was on ground elevated enough to be termed a small knoll. The others were level with or slightly below the adjacent land surface. However, Jones (1963) reported that the greater prairie chicken preferred elevated small patches of natural short grasses with a mean height of 15.1 cm. Anderson (1969) noted that when grass taller than 15 cm was mowed, cocks preferred the shorter, mown areas.

Of the 8 major vegetation types, the clumped midgrass appeared to be most important for nesting and brood rearing. This type, with a summer obstruction index of 2.47 and a mean maximum vegetation height of 42.9 cm, appeared to offer vegetation of the correct visual obstruction and height for nests and young broods. Chamrad and Dodd (1972) observed that vegetation in the immediate vicinity of Attwater's nests was dense to moderately dense, being about 46 cm tall and composed primarily of tall and midgrasses with a few forbs. Hamerstrom (1939) reported vegetation heights above greater prairie chicken nests in Wisconsin ranged from 25 to 70 cm (mean of 45 cm). Evans and Gilbert (1969) noted that medium-dense stands of the taller-grass species on well-drained sites were best for nesting habitat.

Although mown vegetation made it easy to observe broods, the possible brood use of these areas for dusting, avoidance of wet vegetation, and for feeding (both insect and vegetation) may be important. Lehmann (1941) observed that areas of light cover served for feeding and as a refuge when dew was heavy or following rain. He also noted that light to medium-heavy cover was used by Attwater's chicks under 5 weeks old. Of 30 broods he observed in May, all were found in light cover.

The clumped vegetation type provided a stand of tall and midgrasses with a mixture of forbs. These stands were characterized by bunch grasses with scattered openings which provided small areas of reduced cover that could facilitate movement and feeding activities of young broods. Chamrad and Dodd (1972) reported that sufficient cover associated with some openings appeared optimum for successful nesting and brooding activities. Robel et al. (1970a) noted that female greater prairie chickens with broods were frequently located in stands of tall forbs. Jones (1963) observed that greater prairie chicken broods in Oklahoma used areas characterized by short forbs associated with taller forbs which provided resting cover for the chicks.

Roost forms usually were in the clumped midgrass. The bunch grasses and interspersed shorter vegetation contained tall-grass areas and openings that provided roosting cover with a relatively unobstructed view of the surrounding area. Jones (1963) found night roosts of greater prairie chickens located in small pockets of short vegetation within areas of taller vegetation, except during the summer when they selected vegetation relatively uniform in height. Lehmann (1941) noted that Attwater's prairie chickens roosted in light to medium-heavy cover.

The clumped midgrass had the highest PI of the 8 major vegetation types on the study area. The distribution of the vegetation within this type, plus the obstruction index and height, must be favorable to the Attwater's prairie chicken. This type was utilized less in summer when chickens made greater use of the unclumped and transition vegetation types. These latter 2 types had greater mean maximum vegetation height during the summer than did the clumped areas. They were dominated by forbs (sumpweed, *Iva frutescens,* and broomweed, *Xanthocephalum texanum*) during this period, which may have afforded greater cover and protection from the summer heat. Lehmann (1941) noted that heavy cover provided shade for Attwater's prairie chickens during summer. Baker (1953) and Robert et al. (1970a) reported that greater prairie chickens loafed in the shade of shrubs and tall grass in Kansas during the summer.

Observations of chicken use of the cordgrass vegetation type during spring was limited to a single sighting of 9 males and the subsequent location of 6 roost forms in the cordgrass type. This area was adjacent to a hardpan booming ground in the midst of clumped midgrass vegetation in which these males normally roosted.

No use was made of vegetation types invaded by trees or brush. Lehmann (1941) reported that the encroachment of mesquite, live oak, various acacias, and other kinds of brush onto the open prairie was an important factor in reducing the range and numbers of Attwater's prairie chicken.

One booming ground was located in the cropland. Birds were observed in the clumped midgrass and on a road adjacent to this sorghum field on several occasions. Although we did not see chickens feeding in the cropland, Lehmann (1941) observed use of sorghum by Attwater's prairie chicken.

The seasonal use of the 8 vegetation types by the Attwater's prairie chicken was not correlated with visual obstruction or vegetaion height. However, annual mean visual obstruction could be used to separate the frequently used types (clumped midgrass, unclumped midgrass, transition, and hardpan) from the rarely used types (cordgrass, balsamscale, rattlebush, and spiny aster). Robel et al. (1970a) found that visual obstruction density alone was not a significant factor in habitat usage by the greater prairie chicken in Kansas. They noted that other factors such as site, slope, food availability, and location could be involved.

Vegetation height on a seasonal or annual basis could not be used to separate vegetation use in our study, nor could vegetation height and obstruction in combination. The balsamscale, rattlebush, and spiny aster sites could not be separated from the clumped midgrass, unclumped midgrass, transition, and hardpan vegetation types by season. If visual obstruction had been the only important factor, the balsamscale, rattlebush, and spiny aster sites should have been used. Neither rattlebush nor spiny aster could be separated from the frequently used types by mean maximum vegetation height.

It appeared that the balsamscale, rattlebush, and spiny aster vegetation types have seasonal obstruction and heights that should be favorable to the Attwater's prairie chicken. Lehmann (personal communication) has observed Attwater's prairie chicken use of all three.

It appeared that when the mean maximum vegetation height of an area exceeded 55 cm it was avoided by Attwater's prairie chicken. This was observed for the cordgrass and balsamscale vegetation types. Hamerstrom et al. (1957) observed that greater prairie chickens frequented areas that presented a "wide horizons" view. The cordgrass and balsamscale vegetation types did not permit this type of view. Observed use of the balsamscale vegetation type by Lehmann (personal communication) might be explained through the effects of cattle grazing and subsequent lowering of the effective height of the balsamscale. This did not occur in our area due to the moderate grazing pressure.

There was a lack of use of the rattlebush and spiny aster vegetation types although they were considered to be of favorable height. The lack of use of these 2 areas was probably due to soil moisture. Rattlebush was associated with edges of ponds and other low areas maintaining water throughout much of the year. The spiny aster type was associated with creek drainages and frequently was inundated with water. The wetness of these 2 types appeared to preclude use by prairie chickens. Lehmann (personal communication) observed use of these areas during dry summer months. The summers of 1975-76 were characterized as wet. Lehmann (1941) also noted that when water from heavy rains collected in low spots, Attwater's prairie chickens left preferred areas. However, as the water disappeared, the birds returned.

Greater use of the clumped midgrass compared to the unclumped midgrass or the transition areas appeared to be partly due to the greater interspersion of height of the mid- and tall-grass species with a short grass and forb understory. This greater interspersion of height can be shown by comparing the standard deviations of the height measurement in the three vegetation types. The yearly standard deviation for the clumped midgrass areas was 20.2 cm, whereas the standard deviations for the unclumped and transition areas were 15.8 cm and 14.9 cm, respectively. This higher standard deviation for the clumped midgrass area, when the mean maximum height for this type was lower than that of the unclumped midgrass area, indicated a greater interspersion of heights for the clumped vegetation type. Essentially this was due to the clumped nature of the vegetation. Lehmann (1941:30) noted that the best natural range for Attwater's prairie chicken was comprised of terrain with frequent knolls or ridges. He also noted that properly managed grassland satisfied every known requirement of the Attwater's prairie chicken and recommended management be directed toward improvement of those areas.

SUMMARY AND CONCLUSIONS

From February 1975 through June 1977 a study of Attwater's prairie chicken yielded 5,302 observations of activities. Analysis of these data by vegetation type provided the following conclusions:

1. Observations of Attwater's prairie chicken activity indicated preference for four of eight major vegetation types on the study area. However, the clumped midgrass vegetation type received the most year-round use. In addition, artificially-maintained areas received intensive use for booming and feeding.
2. The Attwater's prairie chicken appeared to use those types with short vegetation (hardpan and artificially-maintained areas) for booming, while the taller clumped and unclumped midgrass types were used for nesting and roosting. All four areas were used for feeding.
3. In general, the areas utilized by Attwater's prairie chicken contain an interspersion of height and densities of tall and mid grasses, with scattered open, short vegetation areas. Observations of chicken use of vegetation types correlated with visual obstruction and height measurements of the vegetation. Juxtaposition of utilized vegetation types and soil moisture also influenced chicken use of areas.
4. The moderate cattle grazing, which occurred year-round in the Lake Pasture, and the creation of artificial openings by the presence of roads and mowed areas, appeared to be beneficial to the Attwater's prairie chicken.
5. The protection and proper management of native coastal prairie appeared to be a key factor for maintaining a viable Attwater's prairie chicken population.

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